SINGLE-IMPACT FICHE
ORGANIC FARMING SYSTEMS

IMPACT: ENERGY USE (LCA)

Data extracted in October 2021
Fiche created in March 2024

Note to the reader: This fiche summarises the effects of Organic farming systems on ENERGY USE (LCA). It is based on 3 synthesis papers[1], including from 62 to 164 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

The effect of organic farming systems on Energy use (as calculated in LCA-modelling studies) is reported in **Table 1**.

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- per unit of product: results are variable, depending on the type of product. 2 synthesis papers showed positive effects (i.e. lower energy use) for organic cropping systems in general and in particular for cereals, oils and pulses. Non-significant effects were also found for crops (all types as average) and organic fruits. Negative effects (i.e. higher energy use) were found for organic vegetables production by 1 synthesis paper and for vegetables and fruits (as average) by another synthesis paper.
- For organic livestock products (dairy products, meats) 1 synthesis paper reported positive effect (lowe energy use) and 2 (1 of which of low quality) non-significant effect. 1 synthesis paper reported non-statistically tested results.
- 1 synthesis paper reported positive effect of organic systems (as broad category without distiction on different types).
- per unit of area: no results were available.

All selected synthesis papers included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**. Some synthesis papers may report effects for more than one impact or more than one effect for the same impact.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease energy use (lca)	Energy use per unit of product	Organic cropping systems	Conventional	2	2 (1)	2 (1)	1
		Organic livestock products	Conventional	1	0	2 (1)	1
		Organic systems	Conventional	1	0	0	0

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

2. IMPACTS

The main characteristics and results of the 3 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on Energy use (LCA). The references are ordered chronologically with the most recent publication date first.

[1] Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref11	LCA studies assessing the performance of organic systems in comparison to conventional systems. Emissions are accounted for all 'cradle-to-farm gate' activities.	Global. The majority of LCA publications included in these analyses are from agricultural systems in Europe, North America, and Australia and New Zealand (86% of systems are from these regions). Systems from China (2%), Japan (2%), the rest of Asia (5%), South America (4%), and Africa (4%) are much less common.	164	Organic Cereals, Organic pulses and oil crops, Organic fruits, Organic Vegetables, Organic meats, Organic dairy products and eggs	Conventional systems	Energy use per unit of product	Organic systems use 15% less (p = .0452; n = 33) energy per unit of product, than conventional systems. Significantly lower energy use for dairy products, cereals, oil crops and pulses. Significantly higher energy use for vegetables. No significant effect for meats and fruits.	62%
Ref15	Farm-level studies assessing the performance of organic systems in comparison to conventional systems.	Global	62	Organic systems	Conventional systems	Energy use efficiency. In this analysis, the Energy Analysis Method (EAM), Life Cycle Assessment (LCA), Emergy, and other methods, including Life Cycle Climate Impact (LCCI), are compared.	Significantly lower energy efficiency for organic fruits and vegetables. Although the values for the dairy, livestock, and mixed crop categories were positive, they were not statistically significant.	44%
Ref27	Field studies, modelling studies and Life Cycle Assessment studies of organic systems in comparison to conventional systems in Europe.	Europe	71	Organic production of olives, milk, cereals, beef, pork, ley	Conventional systems	Energy use per unit of product (LCA approach)	This meta-analysis has shown that organic farming in Europe has generally lower energy consumption than conventional farming.	69%

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Decrease energy use (lca)	Energy use per unit of product	Organic cropping systems	Conventional	Ref11 and Ref27	Ref11 and Ref15	Ref11 and Ref15	Ref27
		Organic livestock products	Conventional	Ref11		Ref11 and Ref15	Ref27
		Organic systems	Conventional	Ref27			

3. FACTORS INFLUENCING THE EFFECTS ON ENERGY USE (LCA)

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on Energy use (LCA), according to the synthesis papers reviewed.

Factor	Reference number
Cropping pattern	Ref15
Data sample size	Ref15
Production of mineral fertilisers	Ref27
Type of product	Ref15

4. KNOWLEDGE GAPS

The authors did not report knowledge gaps in the reviewed synthesis papers.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref11	Clark, M; Tilman, D.	2017	Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice.	ENVIRONMENTAL RESEARCH LETTERS 12 6	10.1088/1748-9326/aa6cd5
Ref15	Lee K.S., Choe Y.C., Park S.H.	2015	Measuring the environmental effects of organic farming: A meta-analysis of structural variables in empirical research	JOURNAL OF ENVIRONMENTAL MANAGEMENT 162, 263-274.	10.1016/j.jenvman.2015.07.021
Ref27	Tuomisto HL; Hodge ID; Riordana	2012	Does organic farming reduce environmental impacts? – A meta-analysis of	Journal of Environmental Management 112,	10.1016/j.jenvman.2012.08.018

Ref Num	Author(s)	Year	Title	Journal	DOI
	P; Macdonald DW		European research	309-320	

Disclaimer: These fiches present a large amount of scientific knowledge synthesised to assess farming practices impacts on the environment, climate and productivity. The European Commission maintains this WIKI to enhance public access to information about its initiatives. Our goal is to keep this information timely and accurate. If errors are brought to our attention, we will try to correct them. However, the Commission accepts no responsibility or liability whatsoever with regard to the information on these fiches and WIKI.